FACIES ANALYSIS OF THE EBERSWALDE FAN DELTA (MARS). M. Pondrelli[1], A.P. Rossi[2], L. Marinangeli[1], E. Hauber[3], A. Baliva, [1]IRSPS, Università d'Annunzio, viale Pindaro 42, 65127, Pescara, Italy, monica@irsps.unich.it, [2]RSSD of ESA, ESTEC, The Netherlands, [3]Institute of Planetary Research, German Aerospace Center (DLR), Berlin, Germany.

Introduction: The Eberswalde crater is located immediately Northeast of the Holden crater [1]. The delta-like feature cropping out in the westernmost part of the crater, extending over an area of about 138 km^2, is the most striking morphology inside the crater [2-12]. This feature has been interpreted as a fan delta by most of the authors [2,3,5,6,7,8]. The widespread distribution of > 1m-sized boulders has been observed through HiRISE imagery and [9,10] query whether they could have been transported by normal turbulent flow. Based on HiRise images and anaglyphs [11] noticed that the layering characterizing the delta-like feature is flat-lying, which is not consistent with point bar accretion, and that the cut-bank side of the loop is topographically higher than the inner point bar of the meander bends. On the basis of these elements, [12] proposed debris flow as formation process.

Our aim is to address the sedimentary processes in order to infer the depositional environments and their evolution. In order to achieve these results, a detailed geological analysis has been performed and a tentative facies analysis has been performed. A facies is defined as a distinctive rock that forms under certain conditions of sedimentation, reflecting a particular process or environment. Facies analysis is commonly used to decipher the evolution of sedimentary deposits on Earth.

MOC narrow angle images are available across all of the study area. Moreover, recently released HiRise images covers the delta-like feature. Topographic reconstruction has been highly improved by the HRSC DEM, but MOLA data have been also used.

Facies Analysis: The delta-like feature consists of bright and dark interlayered deposits interpreted to display a cyclic depositional pattern in which bright layers appear to be more resistant to weathering and erosion than the darker layers [8]. The dark layered materials are reworked by wind to form eolian dunes and relatively thin mantles, unlike the bright layered materials. On Earth, dune-forming materials usually fall within a granulometric range between middle sands and granules. When bright layers are found *in situ*, they display two different facies described below.

Polygonal pattern. On the base of HiRise imagery, [10] noted the presence of an extensive polygonal pattern similar to patterned ground on Earth where sandstones with an evaporate-encrusted surface are subjected to thermal contraction [13]. This implies that the area in which these polygons are present underwent exposure to atmospheric condition. The complete HiRise coverage of the feature allows now to observe that polygonal pattern affect most of the bright layers (Fig. 1).

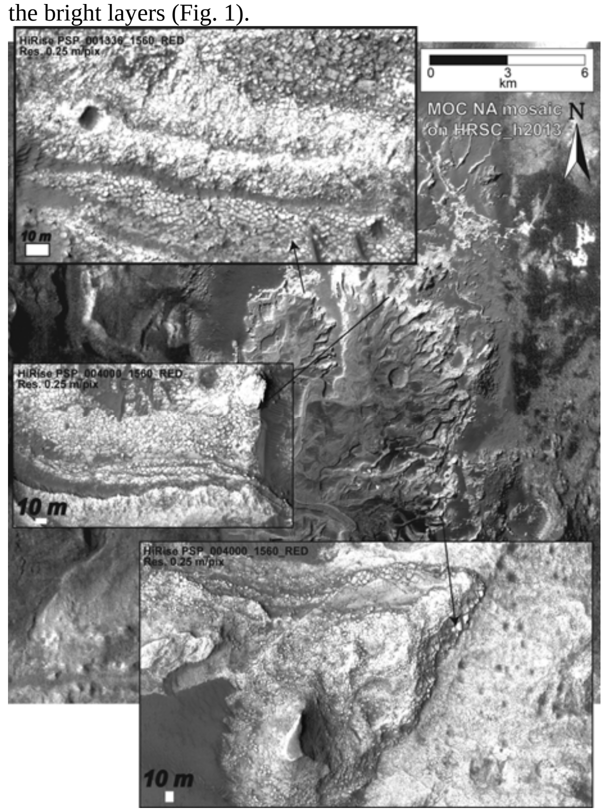

Fig. 1 – Polygonal pattern affect most of the bright layers of the Eberswalde crater.

Channel Facies. A HiRise image details the sequence of a very low sinuous channel (possibly a braided channel) in the outcrop shown in Fig. 2. The channel exposes stacked irregular sedimentary sequences. Each lenticular-like body is approximately a few meters thick, each of which comprises rock materials ranging from boulders grading up to sediments fine enough to be reworked by wind to form eolian dunes. The boulder and gravel deposits consist of bright angular clasts displaying the same geometry and scale of the polygonal features represented in Fig. 1, although smaller. In places, these blocks display a consistent inclination possibly indicating up-current imbrications. The lenticular bodies are mostly poorly sorted, suggesting low textural maturity and clast-supported. A fining upward trend includes much finer sediments near the top of the sequence, which are modified by wind to form eolian dunes (Fig. 2).

Similarly, terrestrial braided channels display comparable fining upward cycles that result from channel abandonment related to lateral migration or avulsion and subsequent infill of the channel by finer sediments. Such activity results in autocyclic sequences distinctive of braided channels. Accordingly, the bright-dark deposits of Fig. 2 are interpreted to mark coarse-grained braid bars interlayered with fine-grained channel infill deposits collectively representing cycles of channel abandonment and infilling. Moreover, the clasts are interpreted to be the reworked product of the polygonal pattern represented in Fig. 1.

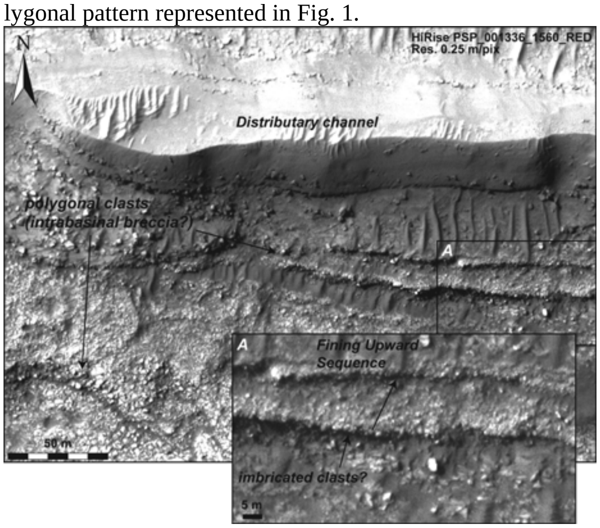

Fig. 2 - Detail of a low sinuous distributary channel sequence exposed in an erosional cut.

Interpretative Scenario: We hypothesized that boulders found in the channel facies might represent polygonal clasts reworked by subsequent fluvial activity to be deposited in channel bars. The breccia cropping out in these channels would thus be intrabasinal breccia locally sourcing from within the depositional basin. Evaporite deposition could have occurred in several settings where bright deposits have been recorded.

Inside the lake and in the submerged part of the fan delta (delta front, where layers are not always horizontal [8]), during periods of low fluvial input, bright evaporites might have draped the dark clastic layers. Then, in correspondence of the delta front, as a consequence either of drops of the water table [14], or periods of dissection, evaporates subjected to subaerial exposure might have developed the thermal contraction-related patterned ground.

In the delta plain, which is mostly subaerially exposed during 'normal' low-stage flows, evaporitic precipitation possibly followed flooding of the flooding plain, which was common as demonstrated by the large number of crevasse splay mapped [8], subsequent evaporation (Fig. 3) and thermal contraction after her plain was subaerially exposed again. During low-stage flows, channels (mostly meandering) would have developed forming mostly dark sandy bars (Fig. 3a). The presence of sand is suggested by the channels morphometry [7], by the fact that these sediments are reworked forming eolian dunes [8] and by the size and shape of the polygonal pattern which are found on top of it [10,13]. Then, during high-stage flows levees breach and flooding of the plain (Fig. 3b) might have lead to salts precipitation from a solution forming the bright layers, which later would have been subjected to thermal contraction creating the polygonal pattern. The bright layers of the delta plain would thus not correspond to point bar surfaces but would just drape the topography of the flood plain during flood stages, thus explaing why they are mostly horizontal. Then, new flows occurring in the same area following avultions might have eroded and reworked the polygons redepositing them in fluvial bars or eventually in the delta plain.

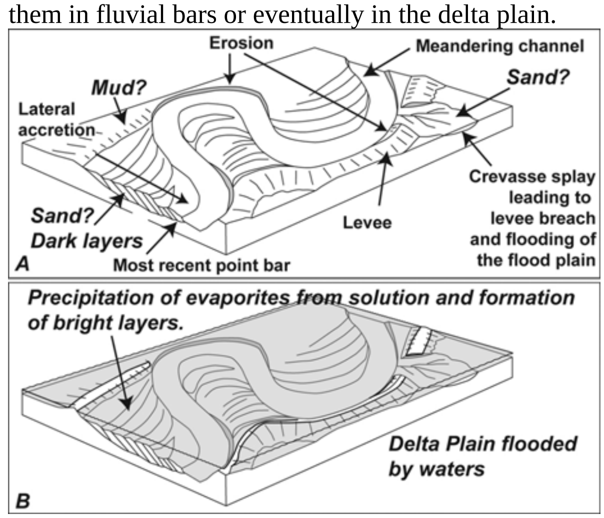

Fig. 3 - Proposed evolution of the delta plain.

We thus favor the hypothesis that the Eberswalde delta-like feature formed as a fan delta. The presence of turbolent flows is not only consistent with the recognized morphologies [8], but also with erosion of some channels by younger channels [14].

In general, remote sensing analyses should be based on the association of as many data as possible, since single evidence could be misleading due to the difficulty to evaluate erosional rates and to quantify tectonic-related modifications which could have affected the system.

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